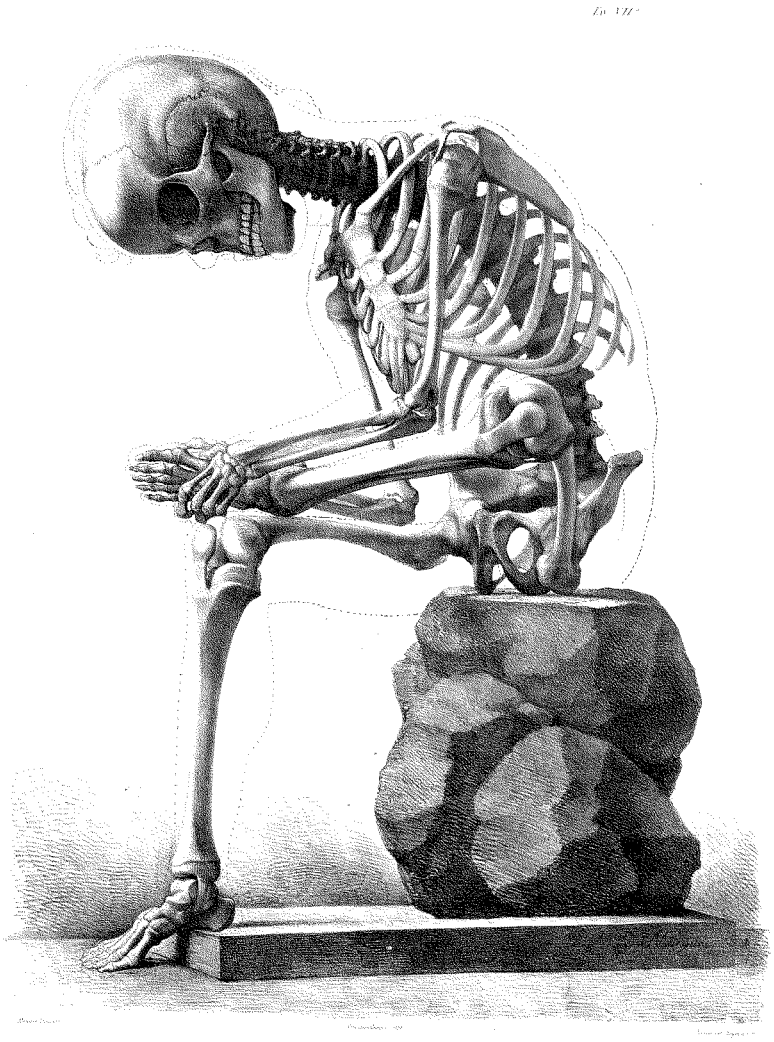
Introduction to
THE HUMAN BODY



BACKGROUND INFORMATION—THE HUMAN BODY

In the animal kingdom, humans are classified as mammals. We are grouped with apes, monkeys, and lemurs in the scientific class *Primates*. Like the bodies of other animals, human bodies are made of cells. Specialized cells make up tissues and organs and groups of organs work together in integrated and organized ways to form **body systems**. Together, the body systems of a human being form a complex and fascinating example of adaptation.

Skin

Our **skin** is the largest organ of the human body. It is not technically part of another body system. An adult has about 20 square feet of skin. It is only three millimeters thick, but acts as a first barrier to heat or cold, bacteria, irritants, allergens, and other dangers from the outside world. Skin also acts as a sensory organ, alerting us to stimuli through our sense of touch.

Skin is made up of two distinct layers. The outer layer is the thinnest and is called the **epidermis**. The epidermis is only about as thick as a sheet of paper. The cells of the epidermis "live" for about 30 days and new cells are constantly added as the older cells dry up and slough off. In fact, the epidermis makes about one and a half million new cells every hour!

The inside layer, the **dermis**, contains blood vessels, nerves, oil and sweat glands. It is 15 to 40 times thicker than the epidermis layer. Together, the two layers help retain body moisture and keep dangerous substances from entering the body.

The sweat glands in the skin help to regulate body temperature. As our bodies heat up, the sweat glands produce sweat on our skin. When it evaporates into the air, heat is lost, cooling the body. In the sunlight, the cells of the skin also make Vitamin D. Vitamin D helps our body absorb the calcium we need for healthy bones.

Skeletal system

Our hard, supportive **skeletal system** is made of bone. Bone is living tissue that is constantly being renewed. It is made up of tiny blood vessels and calcium that requires oxygen and nutrients to supply its cells with energy for growth and maintenance. Oxygen is carried to all parts of the body on special cells called **red blood cells**, which are produced in the bone **marrow** in the center of large bones.

In addition to supporting our bodies and producing red blood cells, bones protect internal organs from impacts. For example, our skull protects our brain and our ribs protect our lungs and heart. Bones also act as levers for our muscles to attach to for movement.

Adults have 206 bones, most of which are found in the hands, wrists, feet, and ankles. Babies are born with about 300 bones, but as they grow, some of the small bones fuse together to form larger bones.

Muscles

Human beings have more than 600 **muscles**. They are a part of every other system in the body. Muscles are organs made up of long, thin cells called muscle fibers. When groups of muscle fibers contract, the whole muscle contracts, causing nearby body parts to move. As muscles are used, they become larger and stronger. Without exercise, they become smaller and weaker.

A single muscle fiber can only contract for a short period. As you work and use a muscle, the muscle fibers take turns contracting. This way, the whole muscle can work for a longer period of time. Still, the muscle will eventually tire and will not contract as easily and efficiently as when the muscle is rested. This is called **muscle fatigue**. Once a muscle is fatigued, it will need to be rested before working effectively again.

There are two groups of muscles: **voluntary muscles** and **involuntary muscles**. Voluntary muscles are those that are under our control. The muscles that move our arms and legs are examples of voluntary muscles. Involuntary muscles cannot be consciously controlled. They work all the time, every day of our lives. The muscles in our heart, stomach, and intestines are involuntary muscles.

Digestive system

The major organs involved in **digestion** are the mouth, the stomach, and the small intestine. There are two types of digestion: mechanical digestion and chemical digestion. **Mechanical digestion** is simply the physical breaking apart of a substance into smaller particles. **Chemical digestion** changes the chemical make-up of the substance by breaking it into its simpler chemical components.

The mouth functions in both mechanical and chemical digestion. When we chew, the teeth break apart the food mechanically. The saliva begins the chemical process of

breaking down starches. The stomach also continues to break apart food mechanically by churning it with involuntary muscle contractions. The food continues to be broken down chemically in the stomach and the small intestine. The stomach contains **hydrochloric acid** (HCl) and a special chemical called **pepsin**. Together, HCl and pepsin chemically break down protein in the stomach. It is in the small intestine where nutrients are absorbed into the bloodstream and carried to the other cells in the body.

The simple components that result from the digestion of food are **nutrients**. There are six categories of nutrients: carbohydrates, fats, proteins, vitamins, minerals and water.

Carbohydrates are the main source of energy for cells. Carbohydrates are made of carbon, oxygen, and hydrogen. They are available in the form of sugar, starch and plant fiber.

Fats are important sources of energy. In large quantities, however, they can contribute to obesity and heart problems.

Proteins are made up of **amino acids**. Amino acids are simple compounds of carbon, oxygen, hydrogen and nitrogen. There are 22 amino acids necessary for human life. Fourteen of these can be made in the human body. However, eight must be consumed in food.

Vitamins are organic compounds available in the food we eat. No single food contains all the vitamins we need for a healthy body, so we need to eat a variety of foods from all the food groups.

Minerals are inorganic chemical elements such as phosphorous, potassium, and calcium that are essential to proper body functions. Minerals help send nerve messages, carry oxygen to cells, and are important for muscle contraction.

Water is necessary for life. All the body's chemical reactions take place in water. Since water is constantly leaving the body when we breathe, sweat, or urinate, it is necessary to drink fluids throughout the day. However, many of the foods we eat also contain water.

Some nutrients, like vitamins and minerals, are needed to help the cells function properly. Other nutrients, like carbohydrates, fats, and proteins, combine with oxygen

to produce energy. The amount of energy a nutrient can produce is measured in **calories**. For example, one gram of fat provides about 9.0 calories of energy. Proteins and carbohydrates provide about 4.9 calories of energy per gram.

Respiratory system

The **respiratory system** includes the nose, mouth, trachea, lungs, and diaphragm. The function of the respiratory system is to obtain oxygen from the air we breathe. Oxygen is used in the cells to help make energy. The **diaphragm** is a large muscle just beneath the chest cavity. When we breathe in, the diaphragm muscle contracts and opens the lungs. This action brings air into the lungs through the nose and mouth, via the wind pipe, or **trachea**. When the diaphragm muscle relaxes, air is expelled to the outside through the trachea, mouth and nose.

In the lungs, there are many tiny, "dead-end" passageways lined with blood vessels. These passageways are called **alveoli**. Just like the oxygen diffusing across a frog's thin, moist skin, the oxygen diffuses across the thin walls of the alveoli into the blood vessels. These blood vessels, called **pulmonary veins**, carry the oxygen from the lungs to the heart to be pumped to the rest of the body.

Blood is carried from the heart to the lungs via different blood vessels called **pulmonary arteries**. In the lungs, carbon dioxide is released and oxygen is picked up, then delivered to the rest of the body by other arteries (see below).

Circulatory system

The **circulatory system** is the "transportation system" for all the substances in the body, including oxygen, nutrients, and carbon dioxide waste. The circulatory system takes oxygen and nutrients to the cells for **respiration**. It also carries the waste products, formed during the chemical reaction of respiration, away from the cells.

The circulatory system is made up of the **heart** and **blood vessels**. The heart is a muscle that pumps the blood through the body. The heart is divided into four cavities, or chambers, through which blood circulates. The human body has about 70,000 miles of blood vessels. Blood vessels that carry blood away from the heart are called **arteries** and blood vessels that carry blood to the heart are called **veins**. The pulmonary arteries that travel from the heart to the lungs carry little oxygen. The pulmonary veins that travel to the heart from the lungs are rich in oxygen. When the oxygen-rich blood arrives at the heart, the heart pumps this blood to the rest of the

body through **systemic arteries**. Blood that passes by respiring cells picks up waste carbon dioxide. This oxygen-poor blood returns to the heart in **systemic veins**. It is then pumped to the lungs so the carbon dioxide can be expelled.

There are several components that make up human blood. About 60% of blood is watery **plasma** that carries the blood's other components through the blood vessels. Blood is also made up of **red blood cells**, **white blood cells**, and **platelets**. Red blood cells contain **hemoglobin** and carry oxygen and carbon dioxide throughout the circulatory system. White blood cells are part of the immune system and help fight infections. Platelets help clot blood when there is a break in a blood vessel, such as a cut in the skin.

Nervous system

The **brain** is made up of millions of cells, which together control the whole human body. The brain sends and receives messages through a network of nerves. The **spinal cord** is the conduit for many of the nerves that go to and from the brain. The eyes, ears, nose, skin, and the tongue sense various changes and send that information by way of the nerves to the brain. The message travels through the nerves at 350 feet per second, allowing the brain to quickly receive the information and react quickly. Overall, the human body has over 10 billion nerve cells that cover every part of the body.

INTRODUCCIÓN AL ESTUDIO DEL CUERPO HUMANO

En el reino animal, los seres humanos están clasificados como mamíferos. Estamos agrupados junto con los simios, los monos y los lémures en la clase científica de los *Primates*. Al igual que el cuerpo de otros animales, el cuerpo humano está compuesto por células. Las células especializadas forman tejidos y órganos y los grupos de órganos funcionan juntos de una manera integrada y organizada constituyendo los **sistemas del cuerpo**. En conjunto, los sistemas del cuerpo de un ser humano reflejan un complejo y fascinante ejemplo de la adaptación.

Piel

La **piel** es el órgano de mayor tamaño del cuerpo humano. Técnicamente, no forma parte de ningún otro sistema corporal. Un adulto tiene aproximadamente 20 pies cuadrados de piel. La piel tiene sólo tres milímetros de grosor pero actúa como defensa inicial ante el frío o el calor, bacterias, irritantes, alergenos y otros peligros del mundo externo. La piel también actúa como un órgano sensorial. A través del sentido del tacto, percibimos los distintos estímulos.

La piel está formada por dos capas diferentes. La capa externa es la más delgada y se conoce como **epidermis**. La epidermis es tan delgada como una hoja de papel. Las células de la epidermis "viven" alrededor de 30 días. Constantemente se están produciendo nuevas células a medida que las más antiguas se secan y degradan. Más aún, ¡la epidermis produce alrededor de un millón y medio de células por hora!

La capa interna de la piel, llamada **dermis**, contiene vasos sanguíneos, nervios y glándulas sebáceas y sudoríparas. Tiene un grosor entre 15 y 40 veces mayor que la epidermis. En conjunto, las dos capas ayudan a retener la humedad corporal e impiden que las sustancias peligrosas entren al cuerpo.

Las glándulas sudoríparas de la piel ayudan a regular la temperatura del cuerpo. A medida que nuestro cuerpo se calienta, las glándulas sudoríparas producen sudoración en la piel. Cuando la sudoración se evapora en el aire, se pierde calor y se enfría el cuerpo. Las células de la piel también producen vitamina D cuando se exponen a la luz solar. La vitamina D ayuda al cuerpo a absorber el calcio que necesitamos para tener huesos sanos.

Sistema esquelético

El poderoso sostén de nuestro **sistema esquelético** está compuesto por hueso. El hueso es un tejido vivo que se renueva constantemente. Está constituido por pequeños vasos sanguíneos y calcio y necesita oxígeno y nutrientes para proporcionar a sus células la energía necesaria para el crecimiento y mantenimiento. El oxígeno se transporta a todas las partes del cuerpo a través de unas células especiales llamadas **glóbulos rojos**, los cuales se producen en la **médula ósea**, la parte central de los grandes huesos.

Además de actuar como un soporte para el cuerpo y de producir glóbulos rojos, los huesos protegen a los órganos internos de los impactos. Por ejemplo, el cráneo protege al cerebro y las costillas protegen a los pulmones y al corazón. Los huesos también actúan como un sistema de palanca, proporcionando un lugar para la inserción de los músculos y permitiendo el movimiento.

Los adultos tienen 206 huesos, la mayoría de los cuales se encuentran en las manos, las muñecas, los pies y los tobillos. Los bebés nacen con 300 huesos, pero al crecer, algunos de éstos se fusionan formando huesos más grandes.

Músculos

El cuerpo humano tiene más de 600 **músculos**. Ellos forman parte de otro sistema del cuerpo. Los músculos son órganos compuestos por células largas y delgadas llamadas fibras musculares. Cuando los grupos de fibras musculares se contraen, todo el músculo se contrae haciendo que las distintas partes del cuerpo de muevan. Cuando los músculos se utilizan, éstos crecen y se fortalecen. Sin ejercicio, se achican y se debilitan.

Una sola fibra muscular se puede contraer únicamente por un corto período de tiempo. Cuando trabajamos y usamos un músculo, las fibras musculares se turnan para contraerse. De esta manera, todo el músculo puede trabajar por un período de tiempo más prolongado. Pero aún así, el músculo finalmente se cansará y no se contraerá tan fácilmente y eficazmente como cuando está descansado. Esto se llama **fatiga muscular**. Una vez que un músculo se ha fatigado, necesitará descansar para poder trabajar de nuevo de una manera eficaz.

Existen dos grupos de músculos: los **músculos voluntarios** y los **músculos involuntarios**. Los músculos voluntarios son aquellos que están bajo nuestro control.

Los músculos que mueven los brazos y las piernas son ejemplos de músculos voluntarios. Los músculos involuntarios no pueden controlarse conscientemente. Ellos trabajan todo el tiempo, todos los días de nuestra vida. Los músculos del corazón, del estómago y de los intestinos son músculos involuntarios.

Sistema digestivo

Los principales órganos involucrados en la **digestión** son la boca, el estómago y el intestino delgado. Existen dos tipos de digestión: la digestión mecánica y la digestión química. La **digestión mecánica** consiste simplemente en fragmentar una sustancia en partículas más pequeñas. La **digestión química** cambia la composición química de estas sustancias degradándolas a sus componentes químicos más simples.

La boca tiene una función tanto en la digestión mecánica como en la química. Cuando masticamos, los dientes desmenuzan los alimentos mecánicamente. La saliva empieza el proceso químico de degradación de almidones. El estómago también continúa descomponiendo los alimentos mecánicamente revolviéndolos con las contracciones de los músculos involuntarios. Los alimentos siguen descomponiéndose químicamente en el estómago y en el intestino delgado. El estómago contiene **ácido clorhídrico** (HCl) y una sustancia química especial llamada **pepsina**. Juntos, el HCl y la pepsina degradan químicamente las proteínas en el estómago. En el intestino delgado, los nutrientes se absorben hacia los vasos sanguíneos y son transportados a otras células del cuerpo.

Los componentes simples que se obtienen de la digestión de los alimentos son los **nutrientes**. Existen seis categorías de nutrientes: carbohidratos, grasas, proteínas, vitaminas, minerales y agua.

Los **carbohidratos** son la principal fuente de energía para las células. Los carbohidratos están compuestos por carbono, oxígeno e hidrógeno. Se encuentran en forma de azúcar, almidón y en las fibras de las plantas.

Las **grasas** son una importante fuente de energía. Sin embargo, en grandes cantidades contribuyen a la obesidad y a los problemas cardíacos.

Las **proteínas** están compuestas por aminoácidos. Los aminoácidos son combinaciones simples de carbono, oxígeno, hidrógeno y nitrógeno. Existen 22 aminoácidos necesarios para la vida humana. Catorce de éstos pueden ser producidos

en el cuerpo humano. Sin embargo, ocho deben ser ingeridos a través de los alimentos.

Las **vitaminas** son compuestos orgánicos que se encuentran en los alimentos que ingerimos. No existe ningún alimento que contenga todas las vitaminas que necesitamos para tener un cuerpo sano, por lo tanto debemos ingerir una variedad de alimentos de todos los grupos alimentarios.

Los **minerales** son elementos químicos inorgánicos, tales como el fósforo, el potasio y el calcio, los cuales son esenciales para las funciones corporales apropiadas. Los minerales ayudan a enviar mensajes a través de los nervios, transportan oxígeno a las células y son importantes para la contracción muscular.

El **agua** es necesaria para la vida. Todas las reacciones químicas del cuerpo involucran la presencia de agua. Debido a que el cuerpo está perdiendo agua constantemente cuando respiramos, transpiramos u orinamos, es necesario beber líquidos durante el día. Sin embargo, muchos de los alimentos que ingerimos también contienen agua.

Algunos nutrientes, como las vitaminas y los minerales, son necesarios para ayudar a que las células funcionen adecuadamente. Otros nutrientes, como los carbohidratos, las grasas y las proteínas, se combinan con oxígeno para producir energía. La cantidad de energía que un nutriente puede producir se mide en calorías. Por ejemplo, un gramo de grasa proporciona aproximadamente 9.0 calorías de energía. Las proteínas y los carbohidratos proporcionan alrededor de 4.9 calorías de energía por gramo.

Sistema respiratorio

El **sistema respiratorio** incluye la nariz, la boca, la tráquea, los pulmones y el diafragma. La función del sistema respiratorio es captar oxígeno desde el aire que respiramos. Las células utilizan el oxígeno para producir energía. El **diafragma** es un músculo grande que se encuentra en la parte inferior de la cavidad torácica. Cuando inspiramos, el diafragma se contrae y expande los pulmones. Esta acción permite que el aire pase a los pulmones a través de la nariz, de la boca y del tubo respiratorio o **tráquea**. Cuando el diafragma se relaja, el aire se expele hacia afuera, a través de la tráquea, de la boca y de la nariz.

En los pulmones, existen muchos pequeños "sacos" rodeados de vasos sanguíneos. Estos sacos se llaman **alvéolos**. De la misma manera que el oxígeno se difunde a

través de la piel delgada y húmeda de una rana, el oxígeno se difunde a través de las delgadas paredes de los alvéolos hacia los vasos sanguíneos. Estos vasos sanguíneos, llamados **venas pulmonares**, transportan el oxígeno desde los pulmones hacia el corazón donde será bombeado al resto del cuerpo.

La sangre es transportada desde el corazón hacia los pulmones a través de diferentes vasos sanguíneos llamados **arterias pulmonares**. En los pulmones, se libera dióxido de carbono y se capta oxígeno, el cual se distribuye al resto del cuerpo a través de las arterias (vea le descripción que sigue).

Sistema circulatorio

El **sistema circulatorio** es el "sistema de transporte" para todas las sustancias en el cuerpo, incluyendo el oxígeno, los nutrientes y los desechos de dióxido de carbono. El sistema circulatorio capta oxígeno y nutrientes para la **respiración** de las células. Además, transporta los productos de desecho provenientes del interior de las células, resultantes de la reacción química de la respiración.

El sistema circulatorio está compuesto por el **corazón** y los **vasos sanguíneos**. El corazón es un músculo que bombea la sangre a través del cuerpo. El corazón está dividido en cuatro cavidades o cámaras, a través de las cuales circula la sangre. El cuerpo humano tiene aproximadamente 70,000 millas de vasos sanguíneos. Los vasos sanguíneos que transportan sangre desde el corazón se llaman **arterias** y los vasos sanguíneos que transportan la sangre hacia el corazón se llaman **venas**. Las arterias pulmonares que llevan sangre desde el corazón hacia los pulmones transportan muy poco oxígeno. Las venas pulmonares que llevan sangre desde los pulmones hacia el corazón son ricas en oxígeno. Cuando la sangre rica en oxígeno llega al corazón, éste la bombea al resto del cuerpo a través de las **arterias sistémicas**. La sangre que pasa cerca de las células que están respirando, capta los desechos de dióxido de carbono. Esta sangre pobre en oxígeno vuelve al corazón a través de las **venas sistémicas**. Entonces es bombeada hacia los pulmones para que el dióxido de carbono se pueda liberar.

La sangre humana tiene varios componentes. Cerca del 60% de la sangre es un líquido llamado **plasma** que transporta los otros componentes de la sangre a través de los vasos sanguíneos. La sangre también está compuesta por **glóbulos rojos**, **glóbulos blancos** y **plaquetas**. Los glóbulos rojos contienen **hemoglobina** y transportan el oxígeno y el dióxido de carbono a través del sistema circulatorio. Los glóbulos blancos

son parte del sistema inmunitario y ayudan a combatir las infecciones. Las plaquetas ayudan a coagular la sangre cuando existe una ruptura de un vaso sanguíneo, como ocurre en una herida de la piel.

Sistema nervioso

El **cerebro** está compuesto por millones de células que en conjunto controlan todo el cuerpo humano. El cerebro envía y recibe mensajes a través de una red de nervios. La **médula espinal** es el conducto por el que circulan muchos nervios hacia y desde el cerebro. Los ojos, los oídos, la nariz, la piel y la lengua perciben estímulos y envían esa información al cerebro a través de los nervios. El mensaje viaja a través de los nervios a 350 pies por segundo, permitiendo que el cerebro reciba y reaccione a la información rápidamente. En total, el ser humano tiene más de 10 billones de células nerviosas distribuidas en todo cuerpo.

THE HUMAN MACHINE

La máquina humana

Grades		
3–8	2 equal groups	45 minutes

Purpose

Students will play a guessing game designed to introduce them to the amazing systems of human beings.

Materials

Teacher Question Sheet
Chalkboard or flip chart paper for scoring.

Concepts

- Body systems are made up of organs that function together.
- Humans have skeletal, digestive, circulatory, nervous, and respiratory systems as well as skin and muscles.
- Skin is an organ that acts as a barrier to the outside world.

Conceptos

- Los sistemas del cuerpo están compuestos por órganos que funcionan en conjunto
- Los seres humanos tienen sistemas esquelético, digestivo, circulatorio, nervioso y respiratorio, así como también piel y músculos.
- Los piel es un órgano que actúa como barrera frente al mundo exterior.

Vocabulary

Organ
Skeletal system
Muscle
Skin
Digestive system
Respiratory system
Circulatory system
Nervous system

Vocabulario

Órgano
Sistema esquelético
Músculo
Piel
Sistema digestivo
Sistema respiratorio
Sistema circulatorio
Sistema nervioso

In Advance

Draw two columns on the chalkboard or flip chart paper to form a scoreboard. Label one column "Team 1" and the second column "Team 2."

Procedure

1. Introduce the game and divide class into teams

Begin by telling students that over the next several days (or weeks) they will be learning about different systems in the human body. Each system is made up of a group of **organs** that works together to keep the body functioning properly. Using the background information for this section, briefly discuss the **skeletal system**, the **muscles**, the **skin**, the **digestive system**, the **respiratory system**, the **circulatory system**, and the **nervous system**. Tell students that they will be playing a guessing game to introduce them to some interesting facts about these organs and **body systems**.

Divide the class into two teams (Team 1 and Team 2) and have the members of each team sit together. Explain that you will begin by asking Team 1 a question. If they answer it correctly, they get a point. If they answer it incorrectly, the other team will have a chance to answer the question. Alternate between the two teams until one team answers the question correctly and gets a point. For the next question, start with Team 2 and alternate teams with each new question.

2. Play the game

Using the Teacher Question Sheet, begin the game. Give the teams a few moments to discuss the question before answering. Keep track of correct answers using the "scorecard." If the teams are having a difficult time with a particular question, you may give them a hint about the answer. The team with the most points at the end wins.

Extensions

Divide the class into seven teams and assign each team a different body system (skin, skeletal system, the muscles, circulatory system, respiratory system, nervous system, or digestive system). Have each team find five more interesting facts about "their" body system. Either ask each team to share their findings with the class or develop questions for the rest of the class to answer.

References

Bosak, Susan V. Science Is...A Source Book of Fascinating Facts, Projects, and Activities. Markham, Ontario, Canada: Scholastic Canada, 1991.

Berger, Melvin and Gilda. Why Don't Haircuts Hurt? New York, NY: Scholastic Inc., 1998.

TEACHER QUESTION SHEET

1. Are you shorter in the morning or at the end of the day? (At the end. The separate bones that make up your backbone are squished together by gravity throughout the day. You may be one inch shorter at the end of the day!)

2. The right side of the brain controls which side of the body? (The left side. The nerve fibers cross over in the brain.)

3. The human body contains 650 of these. (Muscles.)

4. Which facial expression uses more muscles – a smile or a frown? (To make a frown you use 43 muscles. A smile only takes 17 muscles.)

5. Why can't you breathe and swallow at the same time? (Because the throat and nose share the same tube. When you swallow, the tube closes and you can't breathe.)

6. An adult person has 206 of these. (Bones.)

7. The hardest part of the human body is what? (The enamel on your teeth.)

8. Over the average lifetime, the human body does this nearly 3 billion times. (The heart beats.)

9. People who exercise a lot have a faster or slower heartbeat than those who don't exercise when they are resting? (Slower. A healthier heart can pump the same amount of blood with fewer heartbeats.)

10. Everyday we take in more of this than food or water. (Oxygen from the air.)

11. Where are the smallest bones in your body? (In your ears. They are the hammer, anvil, and stirrup bones.)

12. If you made a rope with 10,000 of these, it would be strong enough to lift a car. (Your hair.)

TEACHER QUESTION SHEET (cont.)

13. What is the biggest organ of the body? (The skin.)

14. Name one of the two places where your skin is the thinnest. (The lips or eyelids.)

15. Every year you grow 7 miles of what? (Hair.)

16. Most of the dust in your house comes from what part of your body? (Your skin. 50,000 bits of dead skin cells fall off every minute.)

17. Which two parts of your body have no hair? (The palms of your hands and the soles of your feet.)

18. Which part of an adult's body has 27 bones? (The hand.)

19. Which muscles do you use the most? (The muscles of the eye.)

20. Does your hair grow faster in the summer or in the winter? (The summer because your circulation speeds up in warmer weather.)

21. Who has more bones – an adult or a baby? (Babies have about 300 bones while adults have 206. Some of the bones in a baby fuse to form larger bones as they grow.)

22. When you do this, air comes out of your mouth at 100 miles per hour. (Sneeze.)

23. Which of your bones is the largest? (The thigh bone, or femur.)

24. A signal can travel 350 feet a second on what kind of cell? (A nerve cell.)

CUESTIONARIO DEL MAESTRO

1. ¿Cuándo eres más bajo, en la mañana o al final del día? (Al final del día. Los huesos que componen la columna vertebral se comprimen por la gravedad durante el día. Al final del día puedes medir una pulgada menos.)

2. ¿Qué lado del cuerpo controla el lado derecho del cerebro? (El lado izquierdo. Las fibras nerviosas se cruzan en el cerebro.)

3. El cuerpo humano contiene 650 _____. (Músculos)

4. ¿En cuál expresión facial se utilizan más músculos: al sonreír o al hacer un gesto de enojo? (Al hacer un gesto de enojo utilizas 43 músculos. Para sonreír sólo usamos 17 músculos.)

5. ¿Por qué no puedes respirar y tragar al mismo tiempo? (Porque la garganta y la nariz comparten el mismo tubo. Cuando tragas, el tubo se cierra y no puedes respirar.)

6. Una persona adulta tiene 206 _____. (Huesos)

7. ¿Cuál es la parte más dura del cuerpo humano? (El esmalte de los dientes.)

8. Durante una vida promedio, el _____ aproximadamente 3 billones de veces. (Corazón late.)

9. Al estar en reposo, ¿las personas que realizan ejercicio tienen una frecuencia cardíaca más rápida o más lenta que aquellas que no realizan ejercicio? (Más lenta. Un corazón sano puede bombear la misma cantidad de sangre con unos pocos latidos.)

10. Todos los días consumimos más _____ que alimentos o agua. (Oxígeno del aire.)

11. ¿Dónde se encuentran los huesos más pequeños del cuerpo? (En los oídos. Ellos son el martillo, el yunque y el estribo.)

CUESTIONARIO DEL MAESTRO (cont.)

12. Si fabricas una cuerda con 10,000 _____, sería lo suficientemente fuerte como para levantar un automóvil. (Pelos)

13. ¿Cuál es el órgano más grande del cuerpo? (La piel.)

14. ¿Nombra uno de los dos lugares donde la piel es más delgada. (Los labios o los párpados.)

15. Cada año produces 7 millas de _____. (Pelo)

16. La mayoría del polvo que encuentras en tu hogar proviene de una parte de tu cuerpo. ¿Cuál es? (La piel. Cada minuto caen 50,000 células de piel muerta.)

17. ¿Cuáles son las dos partes del cuerpo que no tienen pelo? (Las palmas de las manos y las plantas de los pies.)

18. ¿Qué parte del cuerpo de un adulto tiene 27 huesos? (La mano.)

19. ¿Cuáles son los músculos que más usas? (Los músculos del ojo.)

20. ¿Cuándo crece el pelo más rápido, en verano o en invierno? (En verano porque la circulación se acelera en climas calurosos.)

21. ¿Quién tiene más huesos, un adulto o un bebé? (Los bebés tienen alrededor de 300 huesos mientras que los adultos tienen 206. Cuando un bebé crece, algunos de los huesos se fusionan formando huesos más grandes.)

22. Cuando _____, el aire sale de la boca a 100 millas por hora. (Estornudas.)

23. ¿Cuál es el hueso más grande? (El hueso del muslo o fémur.)

24. Una señal a través de una célula puede viajar a 350 pies por segundo. ¿A qué célula nos referimos? (A una célula nerviosa.)

FINGERPRINTS
Huellas digitales

Grades		
2–8	5–8	45 minutes

Purpose

Students will observe the unique characteristics of their fingerprints and compare them with other classmates.

Materials

Black ink pads
5 x 7 index cards (one per student)
Pen or pencil
Scissors
Hand lens (optional)
Fingerprint Pattern Diagram

Concepts

- All humans have some traits that are the same and some that vary from person to person.
- No two people have identical fingerprints.
- Because fingerprints are unique in every person, they can be used to identify an individual.

Conceptos

- Todos los humanos tienen algunas características similares y otras que varían de persona a persona.
- No hay dos personas que tengan huellas digitales idénticas.
- Debido a que las huellas digitales son únicas para cada persona, éstas se pueden utilizar para identificar a un individuo.

In Advance

Make a copy of the Fingerprint Pattern Diagram for each student.

Procedure

1. Introduce the activity

Begin by asking students which characteristics most people share. Then ask which characteristics no two humans have in common. Fingerprints are one of the characteristics that vary from person to person. Because no two fingerprints are identical, they can be used to identify different people.

2. Set-up

Divide the class into groups of 5-8 students. Smaller groups will work better for younger students. Larger groups will make the activity more challenging for older students.

Give each student an index card and distribute the ink pads. Have them fold the index card in half, then unfold to form two halves. Have them write their name on one side of each half. (If your index cards have lines on one side, have students write their names on that side.) Tell students they will be making a thumb print in each half, then cutting the index card along the fold.

To make the thumb print, instruct students to press the tip of their right thumb onto the surface of the ink pad and check to make sure the ink is on their thumb. Next, roll the thumb from left to right across one half of the card (the side without their name). Immediately lift the thumb straight from the paper so the fingerprint doesn't smear. Have students repeat the same procedure to make a thumb print in the other half. When they are finished, they should wash and dry their hands.

3. Observe fingerprints

Give each student a copy of the Fingerprint Pattern Diagram and distribute the hand lenses, if available. Have students identify the pattern that best matches their fingerprint.

4. Exchange fingerprints and identify

Instruct each group to make a pile of fingerprints using one thumb print from each group member. The names that identify each thumb print should be face down in the pile. Spread the remaining thumb prints on a table in the center of each group. Tell each group member to take a thumb print from the pile without looking at the name written on the back. Now, see if students can find a "match" among the thumb prints spread out on their table. They can use the Fingerprint Pattern Diagram to narrow

down the choices, but no peeking at the names! When they think they have a match, they should keep the two thumb prints together. When everyone is finished, students can turn over their cards to see if they have a match. Return the fingerprints to the correct person.

5. Discuss

As a class, discuss similarities and differences among the students' fingerprints. Were some very similar? How many students had each type of pattern? Which is the most common pattern of fingerprint in the class? Which pattern is the most unusual?

Questions to Ask During the Activity

1. Why is a fingerprint a good way to identify a person? (Because everyone's fingerprints are unique.)

2. Where else on your body can you find the kinds of skin patterns seen on your fingertips? (On your toes.)

Preguntas sobre el tema de la actividad

1. ¿Por qué una huella digital es una buena manera para identificar a una persona? (Porque las huellas digitales de cada persona son únicas.)

2. ¿En qué otra parte del cuerpo se ve el mismo tipo de configuración que se ve en las huellas digitales? (En los dedos de los pies.)

Why It Happens/More on the Topic

Every organism can be identified by its characteristics or traits. All humans have some traits that are the same, but each individual human also has a set of traits that are different from any other human. Among these individual traits are fingerprints, patterns in the iris of the eye, and voice patterns.

Algo más sobre el tema...

Cada organismo puede ser identificado por sus características o sus rasgos. Todos los humanos tienen algunas características que son iguales, pero también tienen un conjunto de características que son únicas para cada individuo. Entre estas características individuales se encuentran las huellas digitales, la configuración del iris y de la voz.

Modifications

Have younger students (including K-1) work in smaller groups to identify each other's fingerprints. For very young children, help them make one thumb print on the index card and see if they can identify their fingerprint pattern using the Fingerprint Pattern Diagrams, rather than exchanging fingerprints with other classmates.

Extensions

Have students hypothesize what their other fingerprints might look like. Will they be similar to their thumb prints? Will they be different than other students' fingerprints? What about their toe prints? Have students make prints of their other fingers and their toes to see if their hypothesis is correct.

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum. First Edition. Albuquerque, NM, 1996.

FINGERPRINT PATTERN DIAGRAM

Short ridge Dot Enclosure

Trifurcation Hook Bridge Fork

Plain arch

Plain whorl

Loop

Double loop

Tented arch

Central pocket loop

Loop

Accidental (combination type)

PATRÓN DE HUELLAS DIGITALES

Crestas papilares

Varilla *Punto* *Encerrada*

Trifurcación *Gancho o rama* *Puente o crestas cruzadas* *Bifurcación*

Patrones

Arco común

Espiral o remolino

Curva o lazo

Curva o lazo doble

Arco tendido

Isla encerrada en un lazo

Curva o lazo

No estándar o accidental (mixto)

SKELETON SKETCH

Diagrama del esqueleto

Grades		
K–3	2	60 minutes

Purpose

Students will learn about the bones in the human body by drawing their skeleton into an outline of their own body.

Materials

Large sheets of paper (large enough to make a life-sized silhouette for each of your students)
Markers or crayons
Student Activity Sheet

Concepts

- Bones help support our bodies.
- Bones protect the soft organs inside our body.
- Part of our blood is produced inside the long bones of our body.

Conceptos

- Los huesos nos ayudan a sostener el cuerpo.
- Los huesos protegen a los órganos blandos que están dentro del cuerpo.
- Parte de la sangre se produce dentro de los huesos largos del cuerpo.

Vocabulary

Skeleton
Bones
Organs
Blood

Vocabulario

Esqueleto
Huesos
Órganos
Sangre

In Advance

Cut a large sheet of paper for each student in the class. Make copies of the Student Activity Sheet.

Procedure

1. Discuss the function of bones

Ask students if they can think of several reasons why **bones** are important. What would their life be like without bones? Mention that bones support our bodies, protect the soft **organs** inside, and produce a very important component of our **blood**—red blood cells.

2. Draw silhouettes

Divide the class into groups of two. Give each student a large piece of paper and a marker or crayon. Tell the class that one person in each pair will lay down on the sheet of paper and their partner will carefully outline their body. When they are finished, have the pairs trade roles using a new sheet of paper. Be sure students write their names on their paper.

3. Draw skeletons

Give each student a copy of the Student Activity Sheet. Explain that you have given them a diagram of a human **skeleton**. The bones they see on the paper are also in their body. Give students markers or crayons and have them draw the bones in the appropriate places on their silhouette. Give them plenty of time to draw their skeletons.

4. Discuss

Hang the skeleton drawings on the wall. Ask students what they discovered when they were drawing their bones. What part of the body does the skull protect? What soft body parts are protected by the ribs and pelvic bones? What keeps all the bones together?

Questions to Ask During the Activity

1. How many bones are in the leg? (Four bones. One bone in the thigh, two bones in the lower leg, and the kneecap.)

2. How many bones are in the arm? (Three bones. One bone in the upper arm and two in the lower arm.)

3. Which body parts seem to have the most bones? (The hand, wrist, foot, and ankle.)

4. Which is the longest bone in the body? (The thigh bone.)

5. Which is the smallest bone in the body? (The three tiny bones inside the ear. They are so small that they don't even show up on the diagram.)

Preguntas sobre el tema de la actividad

1. ¿Cuántos huesos hay en la pierna? (Cuatro huesos. Un hueso en el muslo, dos huesos en la parte inferior de la pierna y la rótula.)

2. ¿Cuántos huesos hay en el brazo? [Tres huesos. Un hueso en el brazo (parte superior) y dos antebrazo (parte inferior).]

3. ¿Qué partes del cuerpo tienen más huesos? (La mano, la muñeca, el pie y el tobillo.)

4. ¿Cuál es el hueso más largo del cuerpo? (El hueso del muslo.)

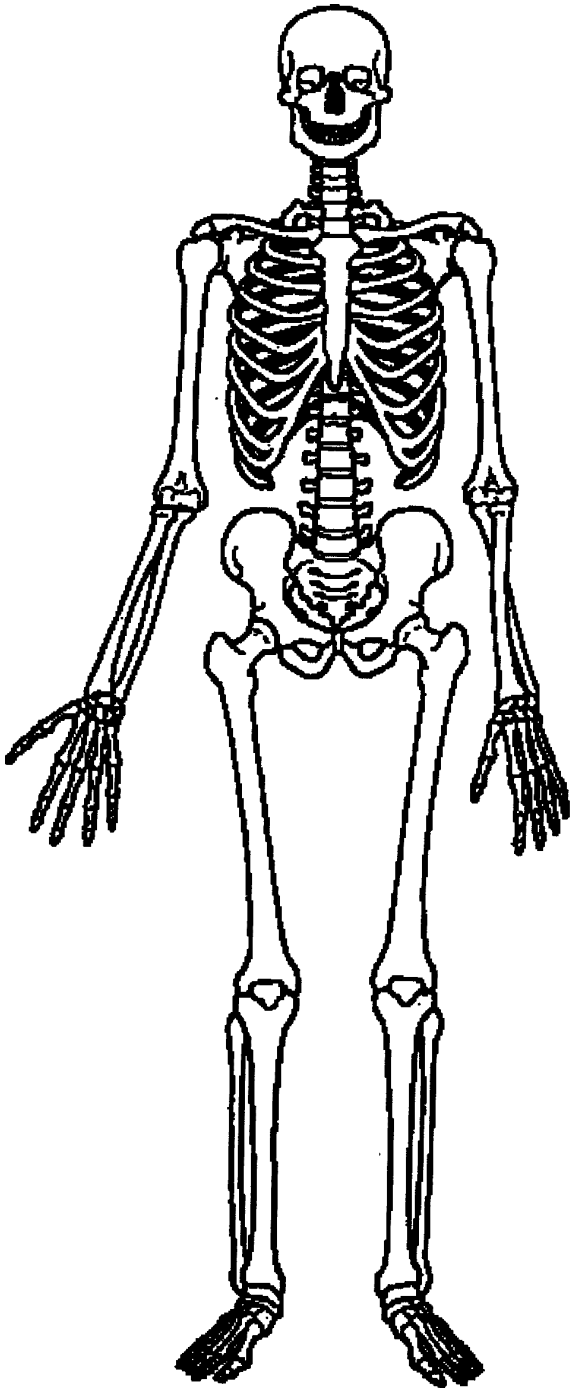
5. ¿Cuál es el hueso más pequeño del cuerpo? (Los tres huesos dentro del oído. Son tan pequeños que incluso no aparecen en el diagrama.)

Extensions

Have students draw the silhouettes again, but instead of drawing their bones, have them draw their internal organs. Discuss the function of each organ when they are finished.

STUDENT ACTIVITY SHEET

Skeleton Sketch/Diagrama del esqueleto



MUSCLES—VOLUNTARY AND INVOLUNTARY

Músculos—voluntarios e involuntarios

Grades		
2–8	2	45 minutes

Purpose

Students will discover if eye blinking is voluntary, involuntary, or both, then determine if blinking has a protective purpose.

Materials

Watch or clock with second hand
Student Activity Sheet
Cotton balls
Plastic wrap, 30cm x 30 cm (one for each pair of students)

Concepts

- Voluntary muscles are muscles that are under our control.
- Involuntary muscles are muscles that are not under our control.
- The muscles of the eyelids are both voluntary and involuntary.
- Eyelid muscles work involuntarily to protect the eyes when somehting is coming towards them suddenly.

Conceptos

- Los músculos voluntarios son los músculos que están bajo nuestro control.
- Los músculos involuntarios son los músculos que no están bajo nuestro control.
- Los músculos de los párpados son tanto voluntarios como involuntarios.
- Los músculos de los párpados actúan involuntariamente para proteger al ojo de amenazas repentinas.

Safety

Plastic wrap should be held away from the face, not on it.

Vocabulary

Involuntary
Voluntary

Vocabulario

Involuntario
Voluntario

In Advance

Make copies of the Student Activity Sheet. Cut pieces of plastic wrap.

Procedure

1. Introduce the activity

Explain the differences between **involuntary** and **voluntary** muscles. Ask students if they think the muscles of the eyelid are involuntary or voluntary. Do they have to remind themselves to blink? Can they stop themselves from blinking? Tell them they will be doing three short experiments to determine if the muscles of the eye are voluntary, involuntary, or both.

2. Procedure for Part A

Divide students into pairs and give each student a copy of the Student Activity Sheet. Explain that they will be entering their data into the chart for Part A.

Have one student in each pair observe his/her partner's eyes for a minute at a time to see how often the partner blinks. The partner should not try to increase or decrease the number of blinks, but should blink naturally. The other student will be counting the number of blinks in one minute. Using a stop watch or clock, tell students when to begin and end counting. Have them record the number of blinks on the Student Activity Sheet. Repeat the procedure three more times, then total and average the number of blinks and record the information on the Student Activity Sheet. Switch roles and have the pairs repeat the procedure.

3. Procedure for Part B

Have one student in each pair look at his/her partner's eyes again. This time the partner should try to hold his/her eyes open as long as possible while you count the number of seconds that pass. When the partner finally blinks, that number of seconds should be recorded on the Student Activity Sheet in Part B. Again, have each pair of students switch roles, repeat the procedure, and record the results. Students should be aware of how their eyes feel after they have held them open as long as possible.

4. Procedure for Part C

Give each pair of students a piece of the plastic wrap and a cotton ball. One student in each pair should hold the plastic wrap in front of their eyes, but it should NOT TOUCH THE FACE. Have the partner throw the cotton ball towards the plastic. The student with the plastic should try not to blink as the cotton ball comes towards him/

her. On the Student Activity Sheet, have students record whether or not there was a blink in response to the cotton ball. Have students repeat this procedure six times, and then switch roles.

Questions to Ask During the Activity

1. Does your data from Part A show that blinking is voluntary or involuntary? (Answers may vary. Students may notice that they are blinking voluntarily or involuntarily.)

2. Does your data from Part B show that blinking is voluntary or involuntary? (Students probably found out that they could control their blinking for a while, and then blinked involuntarily.)

3. Describe how your eyes felt after not blinking in Part B. (Probably students will describe their eyes as feeling dry or gritty.)

4. Does your data from Part C show that blinking is voluntary or involuntary? (Most students would have blinked at least once in response to the cotton ball coming towards them. They might correctly conclude that blinking is both voluntary and involuntary.)

5. How does blinking protect your eyes? (Blinking moistens the eyes and protects them from objects that can be harmful.)

6. What other body system is involved when your eyes blink? (The nervous system. A message travels to and from your brain when your muscles work.)

Preguntas sobre el tema de la actividad

1. Según tus datos de la Parte A, ¿es el parpadeo voluntario o involuntario? (Las preguntas pueden variar. Los estudiantes pueden notar que están parpadeando voluntaria o involuntariamente.)

2. Según tus datos de la Parte B, ¿es el parpadeo voluntario o involuntario? (Probablemente, los estudiantes descubrieron que pueden controlar el parpadeo por un tiempo y que luego parpadean involuntariamente.)

3. Describe cómo sentiste los ojos después de no parpadear durante la actividad de

Preguntas (continuación)

la Parte B. (Probablemente los estudiantes describirán que sienten los ojos secos o arenosos.)

4. Según tus datos de la Parte C, ¿es el parpadeo voluntario o involuntario? (La mayoría de los estudiantes habrá parpadeado por lo menos una vez cuando se acercaba la mota de algodón a los ojos. Es probable que concluyan correctamente que el parpadeo es tanto voluntario como involuntario.)

5. ¿De qué manera el parpadeo protege a los ojos? (El parpadeo humedece los ojos y los protege de objetos que pueden ser peligrosos.)

6. ¿Qué otro sistema del cuerpo está involucrado en el parpadeo de los ojos? (El sistema nervioso. Para que los músculos actúen, es necesario que el cerebro reciba y envíe mensajes.

Why It Happens/More on the Topic

Voluntary muscles are those muscles that are under our control, like leg and arm muscles. Involuntary muscles are not under our control, such as the muscles in our stomach.

Some muscles, like those that close the eyelids, are both voluntary and involuntary. We can decide to open and close our eyelids much of the time, but because it is important to keep our eyes moist and protected, our eyelids also blink involuntarily. The involuntary action of the eyelid muscles enables them to react quickly to sudden stimuli. Our nerves, brain, and muscles work more slowly when we need to think about a reaction consciously, so this involuntary action is more likely to prevent injury.

Algo más sobre el tema...

Los músculos voluntarios son aquellos músculos que están bajo nuestro control, tales como los músculos de las piernas y de los brazos. Los músculos involuntarios no están bajo nuestro control, tales como los músculos del estómago.

Algunos músculos, como los que cierran los párpados, son tanto voluntarios como involuntarios. La mayor parte del tiempo, nosotros podemos decidir si abrimos o cerramos los ojos, pero debido a que es importante mantener los ojos húmedos y

Algo más sobre el tema... (continuación)

protegidos, también parpadeamos involuntariamente. La acción involuntaria de los músculos de los párpados les permite reaccionar rápidamente a estímulos repentinos. Los nervios, el cerebro y los músculos trabajan más lentamente cuando necesitamos pensar concientemente en reaccionar. Por lo tanto, es más probable que la acción involuntaria prevenga el daño.

Modifications

With younger students, only count the number of blinks for each student one time rather than four times. Have them simply record the appropriate numbers for Part A, Part B, and Part C on a sheet of paper rather than using the Student Activity Sheet. Discuss the results as a class.

Extensions

Have students research the three types of muscle tissue: skeletal, smooth, and cardiac. Where are these types of muscles found in the body and what do they do?

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum. First Edition. Albuquerque, NM, 1996.

STUDENT ACTIVITY SHEET

Muscle Action

PART A

Number of blinks per minute

TRIAL	PARTNER	YOU
1		
2		
3		
4		
Total		
Average (total divided by 4)		

PART B

Time without blinking (in seconds)

	PARTNER	YOU
Seconds without blinking		

PART C

Reaction to cotton balls

TRIAL	PARTNER		YOU	
	Did Blink	**Did Not Blink**	**Did Blink**	**Did Not Blink**
1				
2				
3				
4				
5				
6				
Total				

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Acciones de los músculos

PARTE A

Número de parpadeos por minuto

PRUEBA	COMPAÑERO	TÚ
1		
2		
3		
4		
Total		
Promedio (total dividido por 4)		

PARTE B

Tiempo sin parpadear (en segundos)

	COMPAÑERO	TÚ
Segundos sin parpadear		

PARTE C

Respuesta a la mota de algodón

PRUEBA	COMPAÑERO		TÚ	
	Parpadeó	**No parpadeó**	**Parpadeó**	**No parpadeó**
1				
2				
3				
4				
5				
6				
Total				

WORKING MUSCLES

Trabajo muscular

Grades		
3–8	2	45–60 minutes

Purpose

Students will investigate the amount of work their muscles can do under various conditions and discover how their bodies react when muscles are working.

Materials

Clock or stopwatch with second hand
Bucket or bowl filled with 1/2 water and 1/2 ice
Steps or sturdy wooden (or plastic) box
Student Activity Sheet

Concepts

- Muscle fatigue occurs when the energy supply to the muscle cells is depleted and waste products have accumulated.
- When muscles are working, they create heat that causes our bodies to warm up and sometimes sweat.
- Aerobic exercise requires oxygen. To get more oxygen around our body, our breathing rate and heart rate increase.
- Anaerobic exercise doesn't rely on oxygen.
- Muscles work better when they are warm.

Conceptos

- La fatiga muscular se produce cuando se ha agotado el suministro de energía que reciben las células de los músculos y se han acumulado productos de desecho.
- Cuando los músculos están trabajando, producen calor y se eleva la temperatura del cuerpo. Por eso, a veces transpiramos.
- El ejercicio aeróbico requiere oxígeno. Para captar más oxígeno del medio aumentamos la frecuencia respiratoria y la frecuencia cardíaca.
- El ejercicio anaeróbico no depende del oxígeno inhalado.
- Los músculos funcionan mejor cuando están precalentados.

Safety

Do not let students overexert themselves.

Vocabulary

Muscle
Muscle fatigue
Aerobic exercise
Anaerobic exercise

Vocabulario

Músculo
Fatiga muscular
Ejercicio aeróbico
Ejercicio anaeróbico

In Advance

Gather materials and copy Student Activity Sheet.

Procedure

1. Introduce the activity

Tell students that they will be doing two experiments to see how **muscles** are affected by work. One experiment will be to find out how long it takes for a muscle to get **fatigued.** In the other, students will investigate how muscles are affected by temperature.

Divide the students into pairs and give each student a copy of the Student Activity Sheet.

2. Procedure for Part A

Take students to the steps you will be using or set up the wooden or plastic box that can be used like a step. Working in pairs again, students will be stepping up and down as many times as they can in 20 seconds. The same leg should be used to step up each time and the partner will count how many times the student is able to step up and down. Each number should be recorded on the Student Activity Sheet. Tell students they will be doing 6 trials, and then their partner will repeat the same procedure.

When students are ready, have them begin and keep track of their time using the stopwatch or clock. Remind students not to overexert themselves. When everyone is finished, return to the classroom and discuss what changes they noticed as they did more trials. They probably found that they slowed down the more they exercised, they heated up, their heart rate increased, their breathing increased, and perhaps, they began to sweat.

3. Procedure for Part B

Ask students if they have a hypothesis about whether temperature affects the ability of a muscle to do work. Have them record their hypothesis on the Student Activity Sheet.

Tell students to write their full name on the line provided on the Student Activity Sheet. Have one student in each pair hold his/her hand in the bowl of ice water for one minute. When the minute has passed, have the students immediately write their name on the Student Activity Sheet twice. Repeat the procedure with the other member of the pair. When everyone's hands have warmed up, tell them to write their name one more time on the Student Activity Sheet. Do the signatures look different when their hands were different temperatures? Was it easier to write when their hands were cold or warm?

Questions to Ask During the Activity

1. How did your leg feel at the end of Part A? (It should have been fatigued.)

2. What else did you notice about how your body felt at the end of Part A? (Students may have noticed that they were warmer, they were breathing harder, and their hearts were beating faster.)

3. How did the ice affect the muscles of your hand? (The cold should have made it more difficult to work the muscles of the hand.)

Preguntas sobre el tema de la actividad

1. ¿Cómo sentiste la pierna al final de la Parte A? (Debería sentirse fatigada.)

2. ¿Qué otra cosa sentiste en el cuerpo al final de la Parte A? (Los estudiantes pueden haber notado que la temperatura era mayor, que respiraban con más dificultad y que el corazón latía más rápido.)

3. ¿Cómo afecta el frío del hielo a los músculos de la mano? (El frío debería haber hecho más difícil el trabajo de los músculos de la mano.)

Why It Happens/More on the Topic

Fatigue occurs when the energy supply to the muscle cells has been depleted and waste products have accumulated. The muscle cells are unable to respond to stimuli. During moderate exercise, the blood supplies enough oxygen from inhaled air to provide the muscles with energy. This is known as **aerobic** exercise. Actions that require intense, **anaerobic** exertion, such as weight lifting, draw on sources of energy other than inhaled oxygen.

Muscle action produces heat, which in turn can make you feel hot and sweaty when you exercise. Proper exercise, however, can improve the aerobic capacity of the cardiovascular system and decreases the chance of developing cardiovascular disease.

Algo más sobre el tema...

La fatiga ocurre cuando se agota la energía que se suministra a las células del músculo y se han acumulado productos de desecho. Las células musculares son incapaces de responder al estímulo. Durante el ejercicio moderado, la sangre suministra suficiente oxígeno del aire inhalado para proporcionar energía al músculo. Esto se conoce como ejercicio **aeróbico**. Las acciones que requieren un ejercicio **anaeróbico** intenso, tales como levantar pesas, extraen energía de fuentes diferentes del oxígeno inhalado.

La acción muscular produce calor y por eso puedes sentirse acalorado y sudoroso cuando realizas ejercicio. Sin embargo, el ejercicio apropiado puede mejorar la capacidad aeróbica del sistema cardiovascular y disminuir la posibilidad de padecer enfermedades cardiovasculares.

Modifications

With younger students, have them trace a picture rather then write their names in Part B. They also may need help using the Student Activity Sheet.

Extensions

Are muscles as strong when they are fatigued? Have students design and conduct an experiment to see if muscle fatigue affects the strength of muscle contractions.

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum. First Edition. Albuquerque, NM, 1996.

STUDENT ACTIVITY SHEET
Working Muscles

PART A

1. Write the number of steps you made during each trial below:

TRIAL	1	2	3	4	5	6
How many steps?						

PART B

1. How do you think temperature affects the way your muscles work? Write your hypothesis here:

_____

_____

2. Write your name here:

_____

3. After submerging your hand in the ice for one minute, write your name two times below:

_____

_____

4. After your hand warms again, write your name one more time:

_____

5. Was your hypothesis correct?

_____

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Trabajo muscular

PARTE A

1. Escribe aquí el número de pasos que diste en cada prueba:

PRUEBA	1	2	3	4	5	6
¿Cuántos pasos?						

PARTE B

1. ¿Cuál crees que es el efecto de la temperatura en el trabajo muscular? Escribe tu hipótesis a continuación:

_____

_____

_____

2. Escribe tu nombre aquí: _____

3. Sumerge tu mano en el hielo durante un minuto y luego escribe tu nombre dos veces en el espacio a continuación:

_____

_____

4. Después de que tu mano entre en calor nuevamente, escribe tu nombre una vez más:

_____

5. ¿Era correcta tu hipótesis?

_____

PROTEIN DIGESTION
Digestión de proteínas

Grades		
4–8	4–5	55 minutes

Purpose

Students will investigate the conditions needed for pepsin to break down protein.

Materials

For each group:

- Unflavored gelatin
- Dropper
- 2 small glass jars (or 2 test tubes in a rack)
- Large bowl with cold water (if using glass jars)
- Large drinking glass with cold water (if using test tubes)
- Pepsin powder (available from a biological supply company)
- Diluted hydrochloric acid (HCl) (available from a biological supply company)
- Cold water
- Masking tape
- Marker

For each student:

- Student Activity Sheet

Concepts

- Foods are digested both chemically and mechanically.
- Protein is broken down chemically in the stomach using hydrochloric acid and pepsin.

Conceptos

- Los alimentos se digieren tanto química como mecánicamente.
- Las proteínas se degradan químicamente en el estómago por medio de la acción del ácido clorhídrico y la pepsina.

Safety

Hydrochloric acid should be handled carefully. To keep students from getting a mild skin burn, put the drops of hydrochloric acid in the jars yourself. Wash hands thoroughly afterwards.

Vocabulary

Mechanical digestion
Chemical digestion
Protein
Pepsin
Hydrochloric acid

Vocabulario

Digestión mecánica
Digestión química
Proteína
Pepsina
Ácido clorhídrico

In Advance

Mix the gelatin, using the directions on the package. Pour about 10 milliliters into each jar or test tube. Put the jars aside and don't disturb them until the gelatin sets. Gather the materials and copy the Student Activity Sheet.

Procedure

1. Discuss digestion

Ask students if they can describe the digestive process, beginning from the moment food enters their mouth. Describe the difference between **mechanical digestion** and **chemical digestion** and where they take place. Tell students that the chemicals in the mouth begin to digest starches, but the chemical digestion of proteins takes place primarily in the stomach. Today they will be experimenting with the chemicals that break down protein in the stomach.

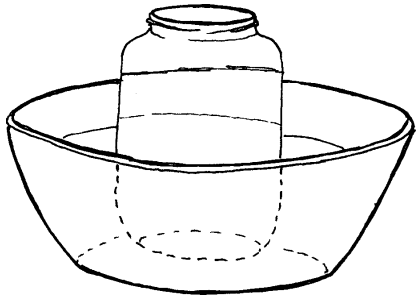
2. Set-up

Divide the class into groups of 4 or 5 students. Give each group two jars with the gelatin. Using the marker and tape, have the groups label one jar "pepsin with acid" and the other jar "pepsin without acid." Tell students that gelatin is made from a protein.

To the jars labeled "pepsin with acid" add 10 drops of diluted hydrochloric acid. To all the jars (with or without acid), sprinkle enough pepsin powder to cover the surface of the gelatin. Put the jars into the containers of cold water, but keep the water from entering the jars (or test tubes).

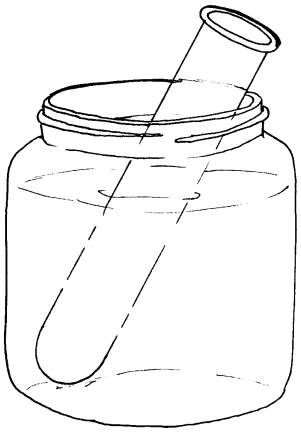
3. Observations

Give each student a copy of the Student Activity Sheet. Have them look at the gelatin in their jars and record their observations on the Student Activity Sheet. At ten minute intervals, have students look at the changes in the jars and record what they see on the Student Activity Sheet.



4. Discuss the data

Ask students what differences they noticed between the jar with acid and the jar without acid. Does pepsin work alone to digest protein in the stomach? Why do they think the jars were placed in the container of water? What might happen if the same two chemicals were used on a piece of meat? A piece of bread?



Questions to Ask During the Activity

1. What is the control in the experiment? (The jar without hydrochloric acid.)

2. What is the variable in the experiment? (The presence of hydrochloric acid.)

Preguntas sobre el tema de la actividad

1. ¿Cuál es el control en el experimento? (El frasco sin ácido clorhídrico.)

2. ¿Cuál es la variable en el experimento? (La presencia de ácido clorhídrico.)

Why It Happens/More on the Topic

In the stomach, pepsin contributes to the chemical digestion of protein. Pepsin is active in the presence of hydrochloric acid. In the jar of gelatin, the pepsin and hydrochloric acid work together to chemically break down the protein. Without the hydrochloric acid, the gelatin changes very little. The cold water keeps the gelatin from becoming a liquid again.

Algo más sobre el tema...

En el estómago, la pepsina contribuye a la digestión química de las proteínas. La pepsina se activa en presencia de ácido clorhídrico. En el frasco con gelatina, la pepsina y el ácido clorhídrico actúan juntos para degradar químicamente las proteínas. Sin el ácido clorhídrico, la gelatina cambia muy poco. El agua fría evita que la gelatina se transforme nuevamente en un líquido.

Modifications

The activity can be done as a demonstration with younger elementary students.

Extensions

Have students develop an experiment to see if protein digestion using pepsin and hydrochloric acid varies with different temperatures. Or, have students use the two chemicals with different types of food (starches, fruit, yogurt, meat, etc.) to see how effective they are.

References

Daniel, Lucy, ed. Merrill Life Science: Laboratory Manual. Teacher Annotated Edition. Columbus, OH: Glencoe Macmillan/McGraw-Hill, 1993.

STUDENT ACTIVITY SHEET
Protein Digestion

1. Record your observations in the chart below:

TIME	PEPSIN WITH ACID	PEPSIN WITHOUT ACID
Beginning		
10 minutes		
20 minutes		
30 minutes		
40 minutes		

2. Describe the changes you observed in the two jars.

3. Based on your observations, what does pepsin need to digest protein?

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE
Digestión de proteínas

1. Anota tus observaciones en el cuadro de abajo:

TIEMPO	PEPSINA CON ÁCIDO	PEPSINA SIN ÁCIDO
Comienzo		
10 minutos		
20 minutos		
30 minutos		
40 minutos		

2. Describe los cambios observados en los dos frascos.

3. De acuerdo a tus observaciones, ¿qué necesita la pepsina para digerir proteínas?

HEART RATE AND DRUGS

Frecuencia cardíaca y drogas

Grades		
4–8	4–5	55 minutes

Purpose

Students will investigate the effects of different drugs on the heart rate of daphnia (water fleas).

Materials

Stop watch or clock with a minute hand
Very dilute solutions of coffee, cola, ethyl alcohol, and cough medicine containing dextromethorphen hydrobromide (Try 1 part drug with 4 parts water for each solution.)
Daphnia culture (enough for 5 animals per group)
Dissecting microscope
4 droppers (one for each solution)
Two large containers (labeled "aged tap water" and "used Daphnia")
Aged tap water (let the water sit undisturbed in a container for a few days)
Well slides
Student Activity Sheet

Concepts

- Stimulants, such as coffee and cola, speed up body functions including heart rate.
- Depressants, such as ethyl alcohol and cough medicine, slow down body functions.

Conceptos

- Los estimulantes, tales como el café y las bebidas cola, aceleran las funciones del cuerpo, incluyendo la frecuencia cardíaca.
- Los depresores, tales como el alcohol etílico y los medicamentos para la tos, reducen las funciones corporales.

Safety

Be sure students don't taste any of the solutions. Review procedures for handling live animals in the classroom.

Vocabulary

Heart rate
Drug
Stimulant
Depressant

Vocabulario

Frecuencia cardíaca
Drogas
Estimulante
Depresor

In Advance

Obtain Daphnia from a biological supply company. Copy Student Activity Sheets. Make dilute solutions of coffee, cola, ethyl alcohol, and cough medicine. Gather other materials.

Procedure

1. Introduce activity

Have students put their hands over their heart and ask them to count their heart beats for 15 seconds. Was everyone's **heart rate** the same? Ask students what factors can affect the rate at which their hearts beat. Be sure to mention that some "**drugs**" increase the heart rate and others decrease it. Tell them they will be investigating how different substances affect the heart rate of a tiny crustacean, to see how those same substances might affect humans.

2. Set-up

Divide the class into groups of 4 or 5 students. Give each student a copy of the Student Activity Sheet. Distribute slides, droppers, and microscopes to each group.

Have each group use a dropper to place a *Daphnia* onto the slide and observe it under the microscope. Tell students to use the diagram on the Student Activity Sheet to locate the heart on their *Daphnia*. When everyone has found the heart, have a student from each group count the number of times the *Daphnia*'s heart beats in 30 seconds. Use the stop watch or second hand on a clock to tell the students when to start and stop counting. Have students record the number of heartbeats on the Student Activity Sheet.

3. Predict

Next, tell students they will be observing how four different drugs affect the *Daphnia*'s heart rate. Have students circle their prediction about whether the drugs are **stimulants** or **depressants** on the Student Activity Sheet.

4. Observe the effects of the drugs on the heart rate

Have students add one drop of the coffee solution to the slide containing the *Daphnia* and wait briefly for the solution to be absorbed by the *Daphnia*. Using the stop watch or clock, have a student in each group count the number of times the heart beats in 30 seconds. (Each student should have at least one chance to count heart beats by the end of the activity.) Tell students to record their number on the Student Activity Sheet.

Using the aged tap water, have students clean the slide by putting the *Daphnia* into the "used Daphnia" container, then rinsing the slide in the "aged tap water."

Repeat the whole procedure using each of the drug solutions. Be sure students count the number of heartbeats for each new *Daphnia* before introducing the drug AND after introducing the drug. Numbers should be recorded on the Student Activity Sheet.

5. Conclusion

For each drug solution, have students determine whether the drug increased (a stimulant) or decreased (a depressant) the heart rate of the *Daphnia*. Were their predictions accurate? Discuss how these same drugs might affect the heart rate in a person.

Daphnia can be saved for other experiments or released.

Questions to Ask During the Activity

1. What was the control in this experiment? (The heart rate of each *Daphnia* before the drug solutions were introduced.)

2. Did the heart rates between each individual Daphnia differ before the drug solutions were introduced? (There probably will be some individual variation just as there is in humans.)

3. How were the *Daphnia* "consuming" the drug solutions? (*Daphnia* are aquatic animals and feed by filtering the water around them.)

4. Which drugs are stimulants? (The coffee and cola speed up the heart rate because they both contain caffeine.)

5. Which drugs are depressants? (The ethyl alcohol and the cough medicine slow

down the heart rate.)

6. How do you think the drugs in this experiment would affect humans? (Generally, the effects on the human heart rate are similar, but it depends on how much of the drug is consumed.)

Preguntas sobre el tema de la actividad

1. ¿Cuál fue el control en este experimento? (La frecuencia cardíaca de cada *Daphnia* antes de administrar las soluciones con drogas.)

2. ¿Era diferente la frecuencia cardíaca de cada *Daphnia* antes de utilizar las soluciones con drogas? (Probablemente existirán algunas variaciones individuales al igual que en los seres humanos.)

3. ¿De qué manera "ingirieron" las soluciones con drogas las *Daphnia*? (Las *Daphnia* son animales acuáticos y se alimentan filtrando el agua que las rodea.)

4. ¿Qué drogas son estimulantes? (El café y las bebidas cola aceleran la frecuencia cardíaca porque ambos contienen cafeína.)

5. ¿Qué drogas son depresoras? (El alcohol etílico y los medicamentos para la tos reducen la frecuencia cardíaca.)

6. ¿Cómo crees que las drogas utilizadas en el experimento afectarían a los seres humanos? (En general, en los seres humanos, el efecto de estas drogas sobre la frecuencia cardíaca es similar al observado en el experimento, pero va a depender de la cantidad de droga que se consuma.)

Why It Happens/More on the Topic

Daphnia, or "water fleas," are small crustaceans that live in freshwater. They are transparent, so it is easy to see their heart working.

Stimulants are substances that cause the body functions to speed up, such as the caffeine in coffee and cola. Depressants are substances that cause the body functions to slow down. The ethyl alcohol and a chemical in many cough medicines act as depressants. The alcohol in alcoholic beverages also acts as a depressant.

Algo más sobre el tema...

Las *Daphnia* o pulgas de agua son pequeños crustáceos que viven en agua fresca. Son transparentes, lo cual facilita la observación del funcionamiento del corazón.

Los estimulantes son sustancias que aceleran las funciones del cuerpo, tales como la cafeína y las bebidas cola. Los depresores son sustancias que reducen las funciones del cuerpo. El alcohol etílico y las sustancias químicas que se encuentran en muchos medicamentos para la tos actúan como depresores. El alcohol de las bebidas alcohólicas también actúa como depresor.

Modifications

If time is limited, divide the class into four groups and have each group use one drug solution on their *Daphnia*. Compare the results of each group to determine which drug solutions are stimulants and which ones are depressants.

Extensions

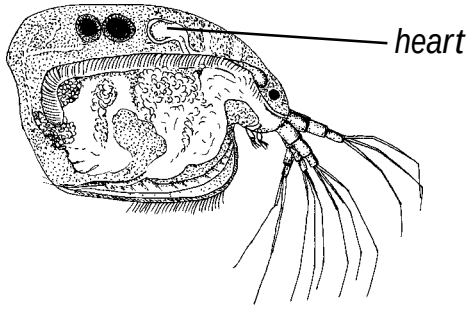
Have students repeat the experiment, but this time, have students observe and record how long it takes the *Daphnia*'s heart rate to return to normal after being exposed to the drug solutions. Which drug affected the *Daphnia's* heart rate the longest?

References

Daniel, Luch, ed. Merrill Life Science: Laboratory Manual. Teacher Annotated Edition. Columbus, OH: Glencoe Macmillian/McGraw-Hill, 1993.

STUDENT ACTIVITY SHEET

Heart Rate and Drugs



1. Predictions: Below each drug type, circle whether you think it is a stimulant or depressant:

Coffee	Cola	Ethyl Alchohol	Cough Medicine
Stimulant	Stimulant	Stimulant	Stimulant
Depressant	Depressant	Depressant	Depressant

2. Write the heart rates in the chart below:

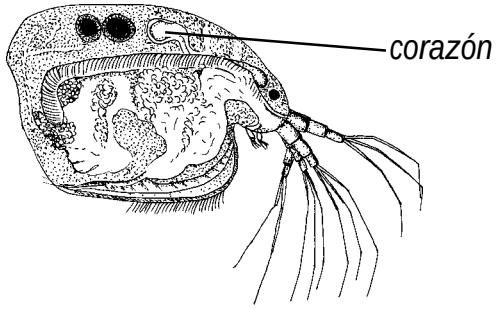
Daphnia 1		Daphnia 2		Daphnia 3		Daphnia 4	
No Drug		No Drug		No Drug		No Drug	
Coffee		Cola		Ethyl Alcohol		Cough Medicine	
Difference=		Difference=		Difference=		Difference=	

3. Were your predictions for each drug solution correct? Why or why not?

4. What was the average heart rate for the four Daphnia before they were exposed to a drug and after they were exposed to the various drugs?

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Frecuencia cardíaca y drogas



1. Predicciones: Debajo de cada tipo de droga, dibuja un círculo alrededor de respuesta correcta (estimulante o un depresor):

Café	**Bebida cola**	**Alcohol etílico**	**Medicamento para la tos**
Estimulante	Estimulante	Estimulante	Estimulante
Depresor	Depresor	Depresor	Depresor

2. Anota las frecuencias cardíacas en el cuadro que aparece a continuación:

Daphnia 1		**Daphnia 2**		**Daphnia 3**		**Daphnia 4**	
Sin Droga		Sin Droga		Sin Droga		Sin Droga	
Café		Bebida cola		Alcohol etílico		Medicina para la tos	
Diferencia=		Diferencia=		Diferencia=		Diferencia=	

3. ¿Fueron correctas tus predicciones para cada droga? ¿Por qué sí o por qué no?

4. ¿Cuál fue el promedio de la frecuencia cardíaca de las cuatro *Daphnia* antes de ser expuestas a una droga y después de ser expuestas a las distintas drogas?